

SITE SUMMARYIssue

- Norfolk Naval Base, Sewells Point Naval Complex  
Q Area Drum Storage Yard (Site 3)

Summary

- Groundwater and soil samples were collected at this site and analyzed for various contaminants. The Interim Remedial Investigation indicated significant organic contamination of groundwater in one well and inorganics in four wells. Soil contamination included organics, BNs, pesticides, inorganics, and oil and grease. Concluded source to be damaged and leaking drums in one area of site. Contaminated soil in that area was removed in 1987.
- Current RI/FS work indicates low level organic contamination, widespread petroleum hydrocarbon contamination, and slightly elevated levels of metals in the soil. Full TCLP extracts were performed for soils and all were below Federal standards. Shallow groundwater samples indicated volatile organics in three wells (chlorinated solvents). Four shallow wells exceeded VWCB standard for TPH. VWCB standards for metals are exceeded in shallow groundwater from three wells. Deep groundwater indicated low levels of volatile organics.

Background

- The site was created in the early 1950s by filling with dredged materials from Willoughby Bay. The drum storage yard has been in use since approximately that time, and tens of thousands of drums have been stored in that time. Types of drummed materials include petroleum, oil lubricants, various organic solvents, paint thinners, and some pesticides, formaldehyde, and acids.

Discussion

- 36 soil borings, 8 shallow (25 feet), and 2 deep (45 feet) groundwater monitoring wells were drilled in September 1989.
- Total volatile concentrations in soils were generally less than 100 ug/kg. PCE was the only volatile detected in TCLP extracts, but was below Federal standards. More than half of the samples exceeded 100 ppm TPH within the fenced area of the site. Metal concentrations were slightly elevated compared to background samples; however, none were above Federal standards for TCLP.

- Shallow groundwater samples from the northern portion of the site indicated volatile organic contamination. VWCB surface water standards for carbon tetrachloride, TCE, and PCE were exceeded in two wells and were detected in a third well. TPH concentrations ranged from 20 to 60 ppm, exceeding VCWB 1 ppm groundwater standard. Groundwater standards for cadmium, chromium, lead, and zinc were exceeded in three wells. The groundwater standard for arsenic was exceeded in two wells.
- One deep groundwater well was drilled as a worst-case scenario. The groundwater sample from that well indicated low level volatile organic contamination (75 ug/L total VOAs). None exceeded VWCB surface water standards for non-public water supply (when available). However, the contaminants found in the deep well were also found in the adjacent shallow nested well, suggesting downward migration of contaminants.

Work Remaining

- Perform pumping test to determine aquifer parameters.
- Using data from aquifer test, model groundwater flow and contaminant transport.
- Perform risk assessment per CERCLA RI/FS requirements.
- Perform feasibility study.

TRC OUTLINE  
Q AREA DRUM STORAGE YARD

I. BACKGROUND

A. Location [Slide 1 ]

1. Site is located on Norfolk Naval Base, part of the Sewells Point Naval Complex
2. Q Area located in northwestern corner of the complex
3. 1000 feet to Elizabeth River and Willoughby Bay

B. Site Description [Slide 2 ]

1. Created by fill operation in early 1950s; disposal area of dredged materials excavated from Willoughby Bay
  - a) in use since then
  - b) tens of thousands of drums
2. Hazardous material
  - a) petroleum, oil lubricants
  - b) various organic solvents, paint thinners
  - c) some pesticides, formaldehyde, acids

C. Geology/Hydrogeology [Slide 3 ]

1. Columbia Group-uppermost geologic unit
  - a) characterized by beds of light-colored clay, sand, and silt
  - b) average thickness ranges from 20 to 50 feet
  - c) an unconfined water table aquifer is associated with the Columbia Group
    - (1) consists of beds and lenses of sand and some gravel, shell beds, silt, sandy clay, and clay
    - (2) sand, shell beds and lenses are major water-bearing strata
    - (3) very heterogeneous and discontinuous

- (4) aquifer can be used only for lawn watering and other similar uses due to water quality limitations
  - low pH, high iron content
  - has typically been contaminated by:
    - waste lagoons
    - landfills
    - septic tanks below the water table
    - municipal sludge application sites
- (5) State Health Department does not allow use of water table aquifer for public water supplies

2. Yorktown Fm. and aquifer

- a) underlies the Columbia Group
  - b) characterized by coarse sand and gravel beds; abundant, thick shell beds
  - c) thickness ranges from 300 to 400 feet
  - d) Yorktown aquifer generally under confined (artesian) conditions
- (1) major water-bearing zones found at depths from 50 to 150 feet
  - (2) generally separated from overlying water table aquifer by confining beds of silt, clay, and sandy clay; 20 to 40 feet thick
    - recharge occurs through downward leakage from water table aquifer
  - (3) domestic, public, commercial, and industrial supply wells are drilled into Yorktown aquifer
  - (4) water quality generally suitable for potable and most other uses
    - occasionally see high iron concentrations
    - locally may have problems with brackish water (high chloride content)

3. Site - Specific Geology/Hydrogeology

- a) the site is underlain by yellow-brown, gray, and black silty sand with shell fragments
- b) brown to black clay lenses are common 20 to 30 feet below surface
- c) water table generally around 8 feet below surface
- d) groundwater flow direction south-southeast

## II. PREVIOUS STUDIES

### A. IAS (February 1983) [Slide 4 ]

1. Onsite phase conducted in May 1982 for Sewells Point Naval Complex
2. Purpose: identify and assess sites posing potential threat to HH&E due to contamination from hazmat operations
3. Q Area was identified as one of 18 potentially contaminated sites
4. During the onsite IAS survey, evidence of considerable leakage and spillage of liquids was found
5. Recommendations were made for installation and quarterly sampling of 3 monitoring wells
  - a) analyze for oil and grease, volatile organic priority pollutants
  - b) locate wells downgradient of storage area with specific attention to leaking drum area

### B. IRP Interim RI (March 1988) [Slide 5 ]

1. Purpose: to determine whether past operations had contaminated site
2. Conducted initial site investigation in November and December 1983
  - a) installed 4 monitoring wells; took 12 soil samples from 4 hand borings
3. Second round sampling of groundwater in August 1984
4. Third round in April 1986 included existing wells and 21 soil samples from 7 locations
5. Navy performed soil sampling in April 1986, following third round [Slide 6]
  - a) eight samples
  - b) result: removal of the most contaminated soil was planned as part of FY-89 Military Construction project
6. Fourth round groundwater sampling June 1986

7. Groundwater [Slide 7 ]

- a) Significant concentrations of organics in GW-01
  - (1) in leaking drum storage area
  - (2) no significant concentrations of constituents present in GW-02, GW-03, GW-04
  - (3) trans 1,2-DCE ranged from 5600 to 9000 ug/L (3 events) in groundwater
  - (4) TCE ranged from 1000 to 6000 ug/L (3 events)
  - (5) concentrations decreased from initial sampling event to third event
  - (6) 1,1,2,2-PCE ranged from 12 to 19 ug/L (2 events)
    - below detection limit of 125 ug/L during 3rd event
- b) Contaminant concentrations in groundwater were compared to:
  - (1) EPA Drinking Water Standards
    - exceeded by vinyl chloride, DCE, TCE, and PCE
  - (2) EPA Water Quality Criteria (toxicity to aquatic life)
    - not exceeded by DCE, TCE and PCE
  - (3) VWCB Groundwater Standards
    - no applicable standards for organics
- c) Inorganic compounds found in all 4 wells
  - (1) arsenic, chromium, zinc found in all 4 wells above VWCB groundwater standards
  - (2) cadmium, lead found in wells GW-01, GW-02, GW-03 above VWCB standards
  - (3) mercury found in wells GW-02, GW-03, GW-04 above VWCB standards
  - (4) considered concentrations to be higher than actual due to unfiltered samples
    - did not consider inorganic contamination significant
      - groundwater not used as potable or non-potable source

8. Soils [Slide 8 ]

- a) contaminants appear to be leaching from soil into groundwater
- b) trans 1,2 DCE and TCE found in soils in same area as well GW-01
  - (1) S-06 contained 1100 to 7000 ug/kg trans 1,2 DCE
  - (2) also contained 16 to 1100 ug/kg TCE
  - (3) concentrations diminished with depth

- c) phenol also found (3400 to 2200 ug/kg)
  - (1) diminished with depth; BDL in bottom sample
  - (2) none in groundwater
- d) seven BNs found in soil adjacent to and outside same area
  - (1) samples S-05 and S-08 (0 to 1-foot depth)
  - (2) also found high oil and grease in soil
  - (3) none in groundwater
- e) three pesticides found at S-07 (various depths)
  - (1) none in groundwater
- f) several inorganics identified in soil samples (S-05, S-06, S-07, S-08)
  - (1) only considered arsenic concentrations as elevated
  - (2) six samples indicated heavily polluted (EPA Reg. V guidelines)
  - (3) five samples indicated moderately polluted (EPA Reg. V guidelines)
- g) oil and grease concentrations ranged from 4120 to 54,100 mg/kg in all eight Navy samples
  - (1) considered heavily polluted (EPA Reg. V guidelines)

9. Conclusions:

- a) source of contaminants is damaged and leaking containers
- b) organics leaching from soil into groundwater in that area
- c) soil may be absorbing some of volatiles, but not inorganics

10. Recommendations [Slide 9 ]

- a) need downgradient wells
- b) install three additional nested wells and sample
- c) collect additional soil samples; analyze metals, EP TOX, TPH, ignitability
- d) if not hazardous, cap entire drum storage yard
- e) contain damaged/leaking drums

11. 750 cubic yards of soil excavated in 1987 [Slide 10 ]

- a) area now paved

### III. CURRENT WORK

#### A. RI/FS and Risk Assessment [Slide 11]

1. Field work for the RI/FS began in September 1990
2. 36 soil borings were hand-augered to 3 feet
3. Ten monitoring wells were installed; eight shallow (20 feet) and 2 deep (40 feet)
  - a) one composite soil sample from each well
  - b) two groundwater samples from each shallow well; one from each deep well
4. A groundwater pumping test is yet to be performed to determine aquifer characteristics
5. Q Area was divided into four areas, according to known storage practices
  - a) hazardous materials area
  - b) petroleum product area
  - c) transit area
  - d) truck and equipment storage yard
6. Majority of drums have been moved to CD drum storage area
  - a) currently stored in sheds with secondary containment and drains to fuel oil recovery system
7. Soil boring locations chosen to randomly cover various scenarios in the 4 areas
  - a) obvious spills
  - b) clean areas
  - c) adjacent to cement drum storage footings
  - d) middle of rows of drums
  - e) low traffic areas
8. Monitoring well locations chosen to detect onsite contamination and offsite contaminant migration
  - a) wells were placed in successively downgradient positions
    - (1) to monitor potential migration of contaminants from hazardous materials, petroleum products, and transit areas



- (2) two deep wells originally drilled to test deeper aquifer zone
  - no confining layer found between shallow wells and base of deep wells
  - hydraulically connected; did not penetrate deep aquifer

B. RI/FS Analytical Results

1. Soils [Slide 12 ]

a) Volatile organics

- (1) generally low level
- (2) hazardous materials area most contaminated
  - generally less than 100 ug/kg, even for total volatiles
  - PCE was 32,000 at HM-9-2 in vicinity of leaking/damaged drums
    - PCE detected in 2 TCLP extracts (HM-1 and its field dup), but below Federal standards
- (3) acetone was common in transit area (ND-650 ug/kg), but was not detected in TCLP extracts

b) TPH

- (1) widespread contamination in the TA, PP, and HM areas
  - only one sample contained TPH in EY (<100 ppm)
  - concentrations from ND to 4400 ppm
  - >1/2 of samples in TA, PP, and HM areas exceed VWCB 100 ppm TPH guideline for disposal of petroleum-contaminated soil in sanitary or industrial landfill
  - >2/3 of the samples in the TA, PP, and HM areas exceed VWCB 50 ppm TPH guideline for clean fill
  - GC fingerprint matches majority to compressor oil
    - also some lube oil
    - minor Number 6 fuel oil, motor oil, hydraulic jack oil
    - five samples did not match any reference standard

c) Metals

- (1) northern PP and TA areas have levels of metals slightly higher than background and other areas onsite
  - none above TCLP standards
  - some may relate to metal contamination in groundwater, but difficult to compare

2. Groundwater (shallow) [Slide 13 ]

a) Volatile organics

- (1) highest degree of contamination in HM area and northern portion of PP area
- (2) total VOAs highest in SW-2 (7800 ug/L)
- (3) contaminants include: PCE, TCE, TCA, DCE, DCA, and acetone
  - no VWCB standards for above in groundwater
  - VWCB proposed standards for carbon tetrachloride in surface water (non-public water supply) are exceeded in wells SW-1 and SW-2
  - VWCB proposed standards for TCE and PCE in surface water exceeded in SW-2
  - no surface water standards for acetone, DCE, 1,1 DCA
- (4) same contaminants in SW-1 and SW-6
- (5) concentration of total VOAs is relatively low in SW-3, SW-4, SW-5, SW-7

b) TPH

- (1) ranged from 20 to 60 ppm, but undetected in SW-2, SW-3, SW-4
- (2) SW-1, SW-5, SW-6, SW-7 all exceed VWCB 1 ppm standard for TPH in groundwater
- (3) TPH fingerprint did not match any of the reference standards
- (4) possibly due to degradation

c) Metals

- (1) groundwater contamination appears in the TA and northwestern PP areas
- (2) VWCB groundwater standards are exceeded for Cd, Cr, Pb, Zn in SW-2, SW-4, SW-5
- (3) VWCB groundwater standards exceeded for arsenic in SW-2, SW-5
- (4) appears a relationship could exist between metals contamination in soil and groundwater
  - can not be substantiated
  - soils analyzed for TCLP metals, rather than total metals
  - can not compare values for TCLP metals and PP metals

3. Groundwater (deep) [Slide 14 ]

a) Volatile organics

- (1) both DW-1 and DW-2 have chloroform (19 and 60 ug/L, respectively)
  - no VWCB standards for above in groundwater
  - below VWCB proposed surface water standard for non-public water supply (470 ug/L)
  - possibly due to drilling fluid (contained 250 ug/kg)
- (2) total VOAs:
  - DW-2 (background well): 182 ug/L (acetone 160 ug/L)
    - contaminants include: 1,1 DCE and methylene chloride (also in blank)
    - no VWCB standards for above in groundwater or surface water (non-public water supply)
  - DW-1: 75 ug/L
    - contaminants include: 1,1 DCE, methylene chloride (also in blank), 1,1 TCA, bromodichloromethane, TCE, and PCE
    - no VWCB standards for above in groundwater
    - no VWCB proposed standards for 1,1 DCE, methylene chloride, bromodichloromethane in surface water (non-public supply)
    - remaining compounds do not exceed VWCB proposed surface water standards
    - contaminants (except bromodichloromethane) also in nested well SW-2

C. RI/FS work remaining [Slide 15 ]

1. Pumping test
2. Groundwater flow and transport modeling
3. Risk assessment
4. Feasibility study



Figure 1 Site Location Map  
Q Area Drum Storage Yard  
Norfolk Naval Base  
Norfolk, Virginia



Environmental  
Science &  
Engineering, Inc.

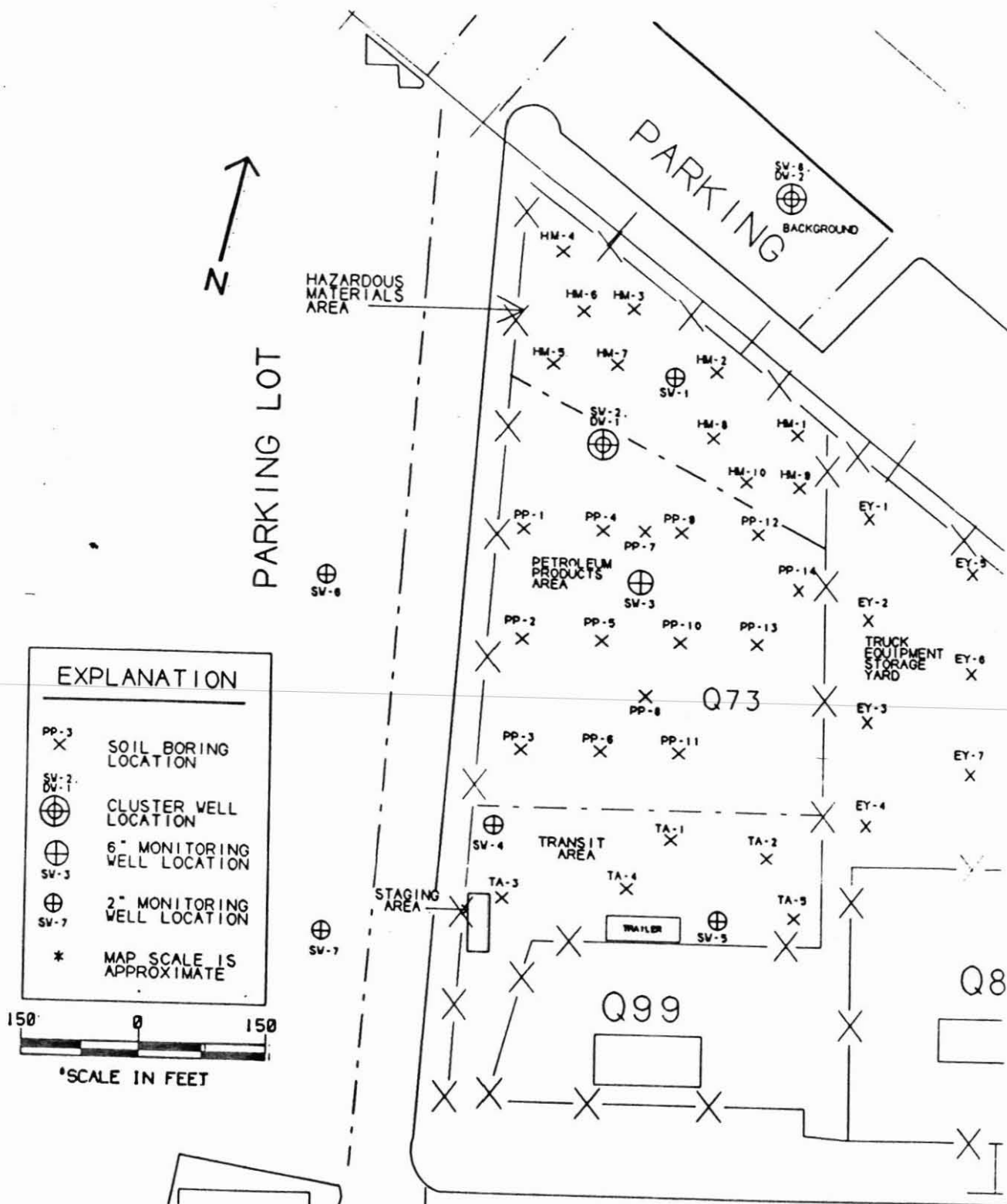


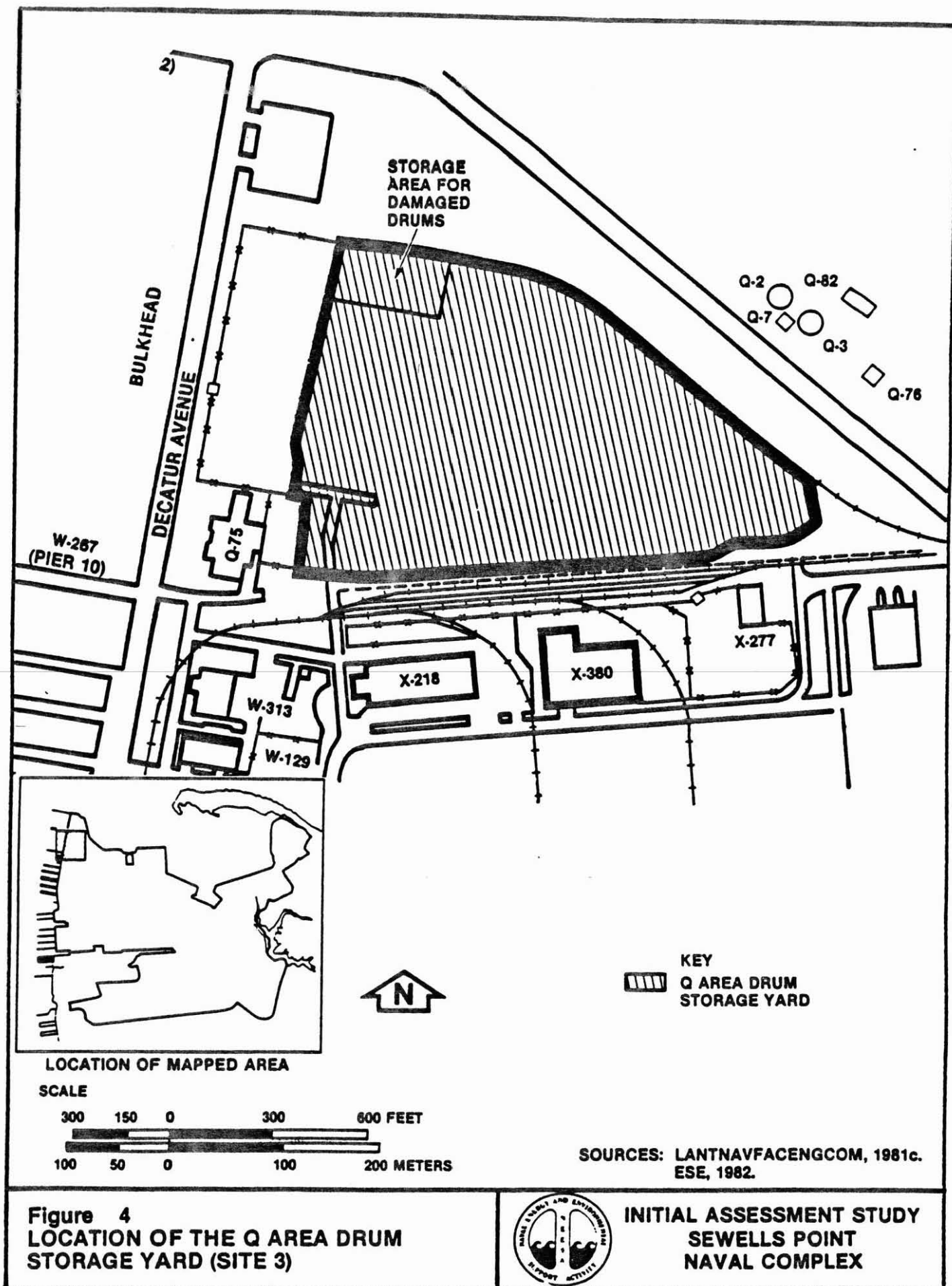
Figure 2  
Soil Boring and Monitoring Well Locations, Q Area  
Drum Storage Yard, Norfolk Naval Base, Norfolk, VA



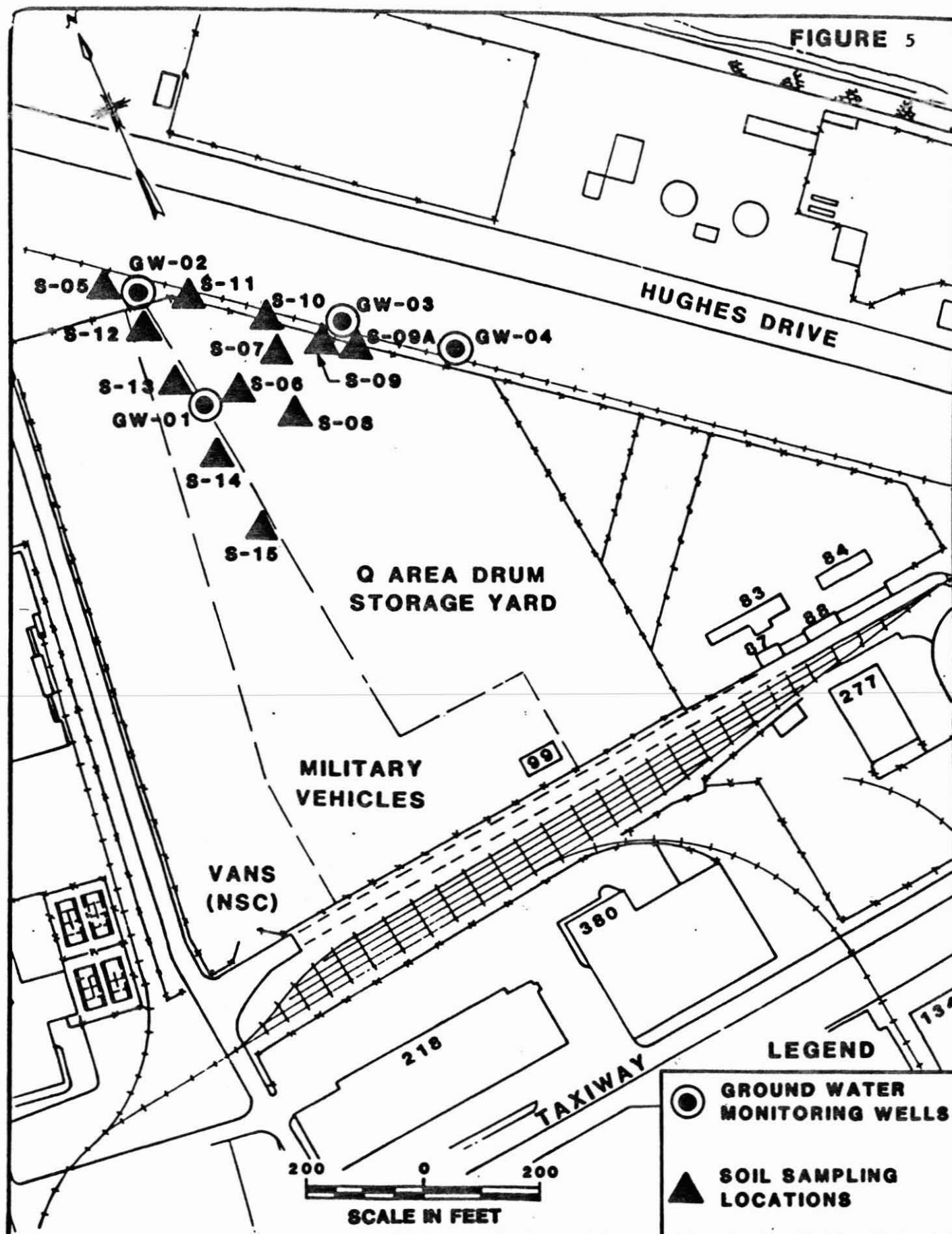
FIGURE 3 - STRATIGRAPHIC AND HYDROGEOLOGIC UNITS - SOUTHEASTERN VIRGINIA

		NORTH CAROLINA		VIRGINIA				
SYSTEM	SERIES	STRATIGRAPHIC UNITS	HYDROGEOLOGIC UNITS		STRATIGRAPHIC UNITS	HYDROGEOLOGIC UNITS	DESCRIPTION OF HYDROGEOLOGIC UNITS	
QUATERNARY	RECENT PLEISTOCENE	POST-MIOCENE (UN- DIFFERENTIATED)	WATER TABLE OR QUATERNARY AQUIFER		RECENT COLUMBIA GROUP	WATER TABLE OR QUATERNARY AQUIFER	Unconsolidated sand, silt, and some gravel. Sand units yield quantities adequate for domestic and small industrial demands, used extensively for lawn watering. Unconfined aquifer.	
TERTIARY	UPPER	YORKTOWN  PUNGO RIVER	TERTIARY AQUIFER SYSTEM	SAND AQUIFER	CHESAPEAKE GROUP	YORKTOWN	Sand and shell beds main water- bearing units. Adequate for mod- erate public and industrial supplies. Artesian	
	MIDDLE					CALVERT	CONFINING UNITS	Silt and clay predominant, minor sand lenses.
	EOCENE	CASTLE HAYNE LIMESTONE		LIMESTONE AQUIFER	NANJEMOY	NOT FOUND IN STUDY AREA		
	PALEOCENE	BEAUFORT			MATTAPONI	EOCENE-UPPER CRETACEOUS AQUIFER	Glauconitic sand and interbedded clay and silt. Infrequently used as a water supply. Yields adequ- ate for moderate supplies. Brackish in most of area. Artesian	
CRETACEOUS	UPPER	PEEDEE	CRETACEOUS AQUIFER SYSTEM	UPPER UNIT	LOWER CRETACEOUS	TRANSITIONAL BEDS	LOWER CRETACEOUS	Interbedded gravel, sand, silt, and clay. Yields are adequate for large industrial use. Brack- ish in most of area. Artesian
	LOWER	BLACK CREEK  UNNAMED		LOWER UNIT		PATUXENT		





**FIGURE 5**

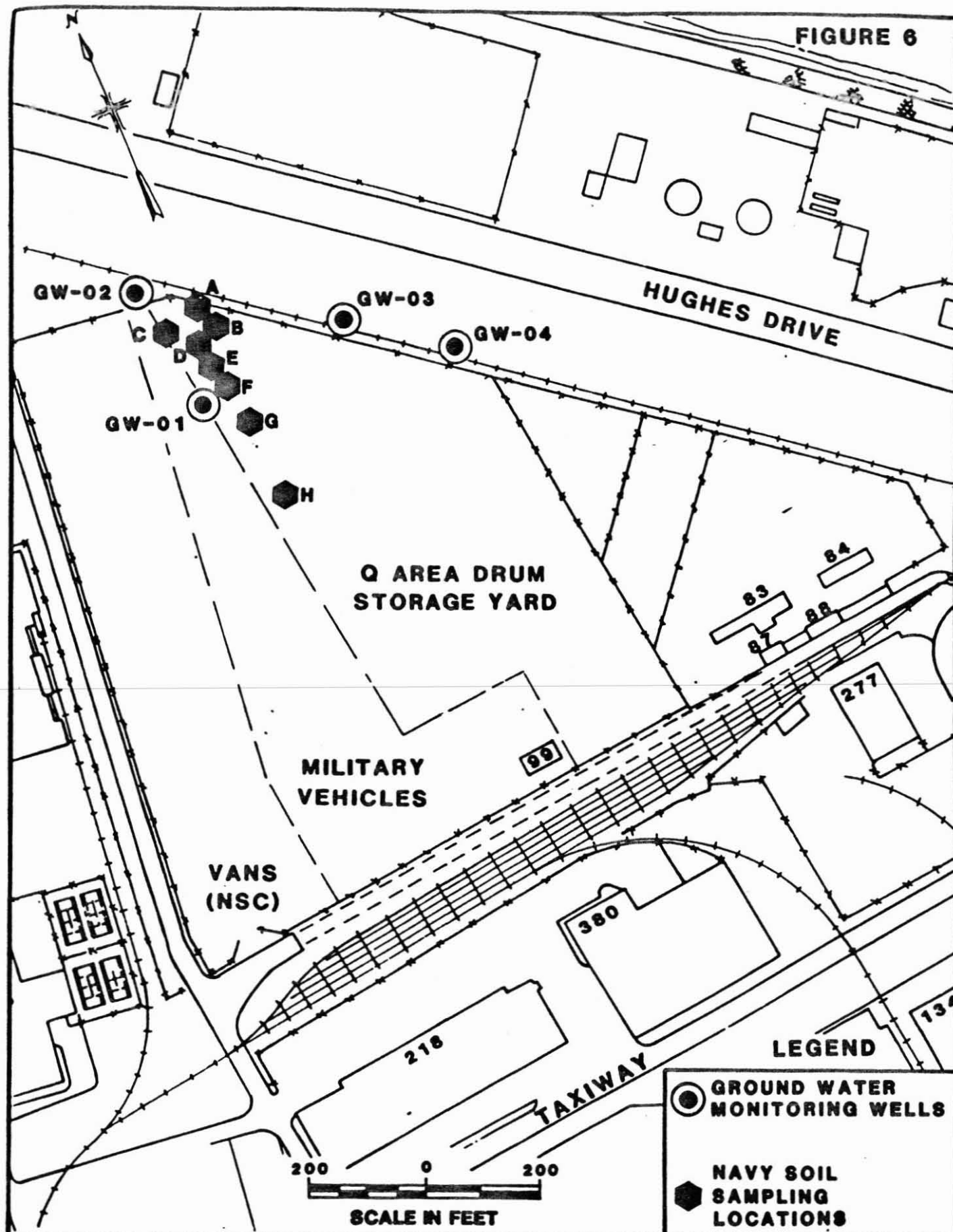


**NAVAL BASE NORFOLK, VIRGINIA  
Q AREA DRUM STORAGE YARD (SITE 3)  
GW AND SOIL SAMPLING LOCATIONS**

**MARCH 1988**



FIGURE 6



NAVAL BASE NORFOLK, VIRGINIA  
**Q AREA DRUM STORAGE YARD (SITE 3)**  
**NAVY SOIL SAMPLING LOCATIONS**

MARCH 1988

FIGURE 7. INTERIM RI GROUNDWATER ANALYTICAL RESULTS

Volatile Organic Results (ug/l)

	GW-01	GW-02	GW-03	GW-04	EPA Drinking Water Standards	Water Quality Standards
vinyl chloride	BDL - 24	BDL	BDL	BDL	2	NA
trans 1,2-DCE	5600 - 8000	BDL	BDL	BDL	0.33	11600
TCE	1000 - 6000	BDL	BDL	BDL	27	45000
PCE	BDL - 19	BDL	BDL	BDL	0.8	450

Inorganic Results (mg/l)

	GW-01	GW-02	GW-03	GW-04	VWCB Ground- water Standard
arsenic	BDL - 0.20	BDL - 0.13	BDL - 0.20	BDL - 0.50	0.05
cadmium	0.01 - 0.02	BDL - 0.02	BDL - 0.09	BDL	0.0004
chromium	BDL - 0.10	BDL - 0.22	BDL - 0.45	0.08 - 140.00	0.05
lead	BDL - 0.30	BDL - 0.23	BDL - 0.32	BDL	0.05
mercury	BDL	BDL - 0.0007	BDL - 0.001	BDL - 0.00078	0.00005
zinc	BDL - 0.30	0.04 - 0.30	BDL - 0.40	0.05 - 0.30	0.05

FIGURE 8. INTERIM RI SOIL ANALYTICAL RESULTS (ug/kg)

	S-05	S-06	S-07	S-08
trans 1,2-DCE	BDL	16 - 1100	BDL - 83	BDL
TCE	BDL	1100 - 7000	BDL	BDL
phenol	BDL	BDL - 3400	BDL	BDL
total BNs		BDL - 380	BDL	BDL - 21,600
total pesticides	BDL	BDL	3.7 - 167.8	BDL - 800

	S-05	S-06	S-07	S-08	Region V Guidelines		
					Non	Moderately Polluted	Heavily
arsenic (ug/g)	BDL - 23	5.3 - 21	4.7 - 14	6.2 - 32	<3	3 - 8	>8

Navy Soil Samples (mg/kg)

	Range	Mean			
oil & grease	4120 - 54,100	24,588	<1000	1000 - 2000	>2000

FIGURE 9

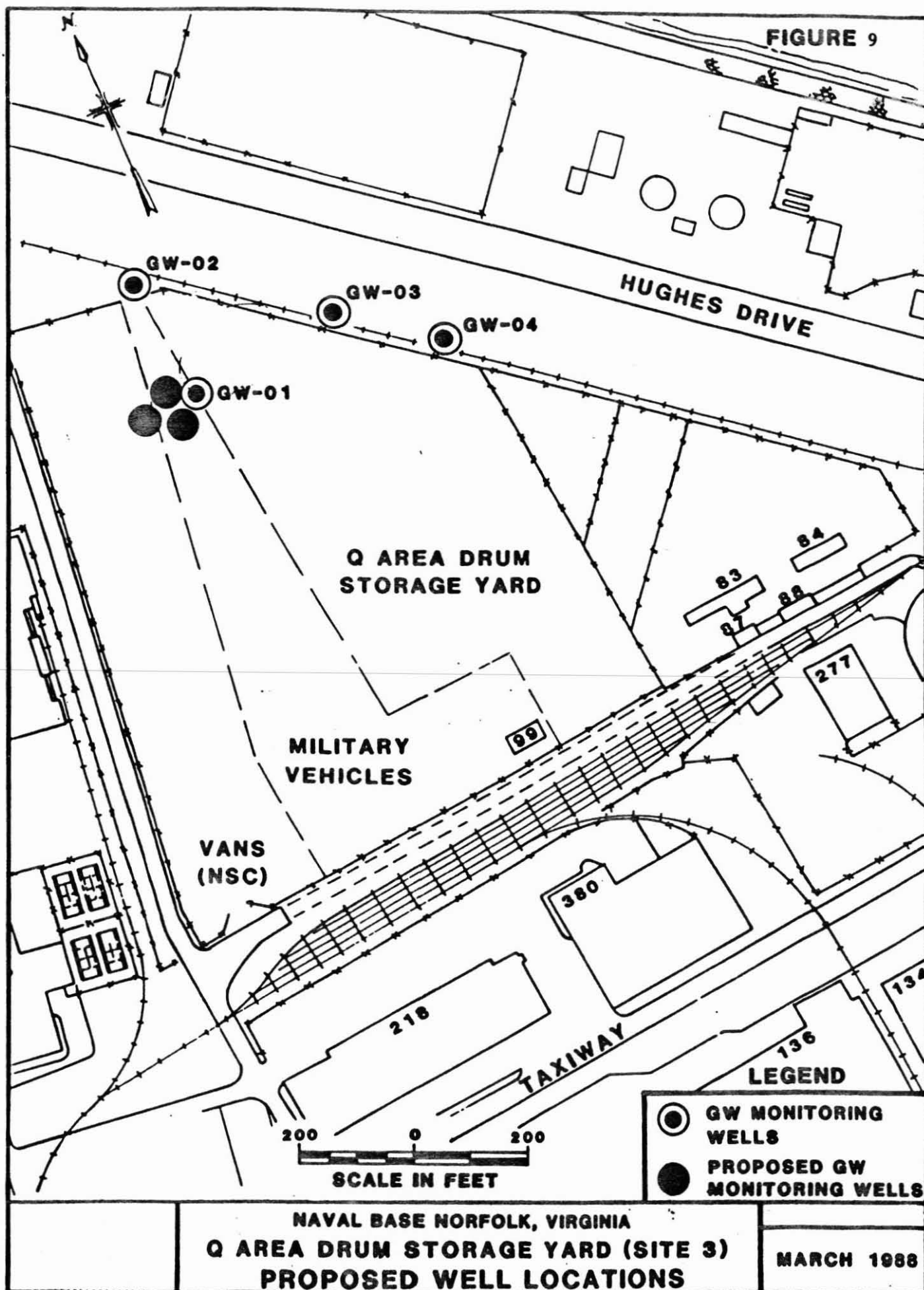
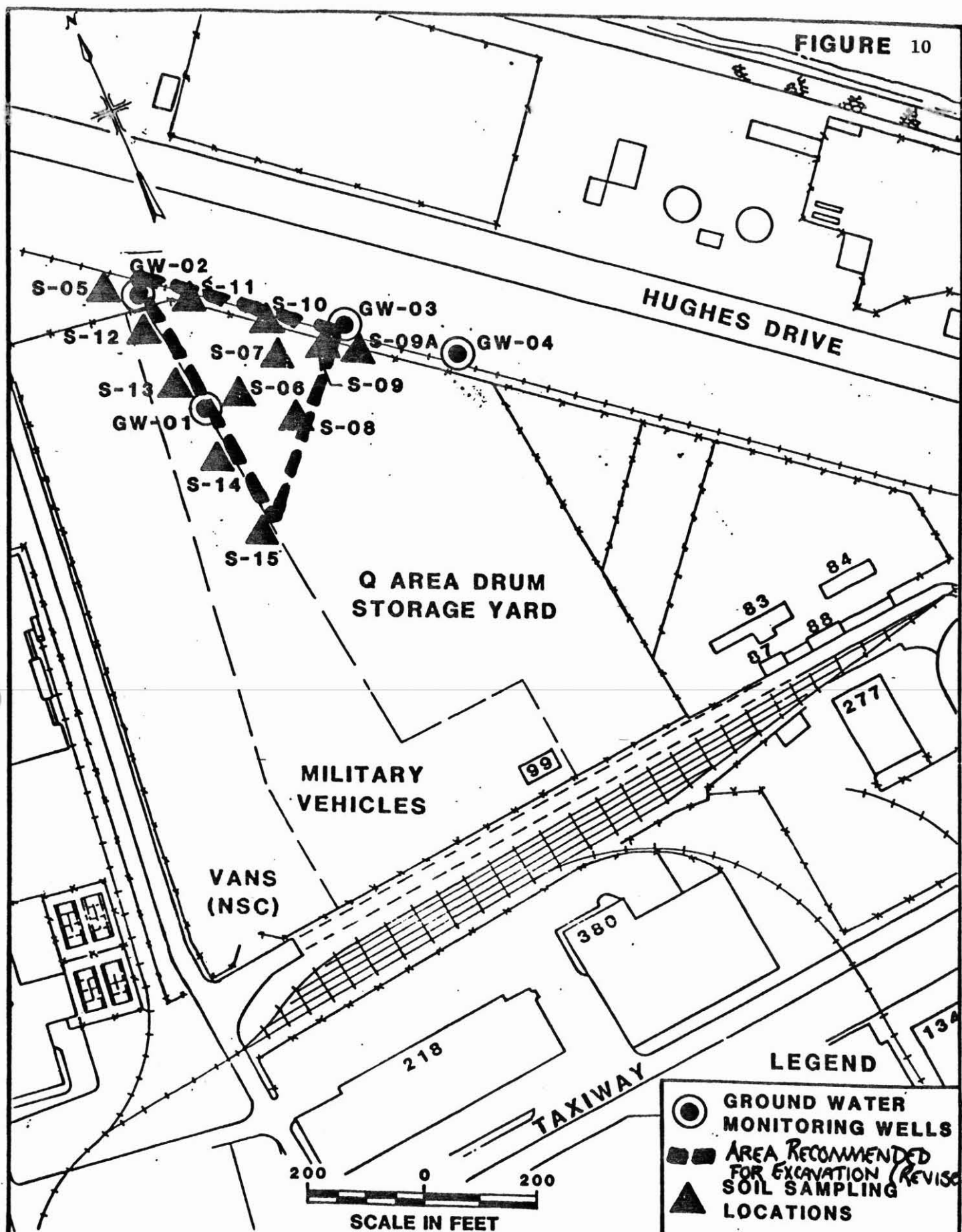


FIGURE 10



SEWELL'S POINT NAVAL BASE, NORFOLK, VIRGINIA  
 Q AREA DRUM STORAGE YARD (SITE 3)  
 GW AND SOIL SAMPLING LOCATIONS

MARCH 1987



FIGURE 12. RI/FS SOIL ANALYTICAL RESULTS (ug/kg)

	Range	Mean	Background
methylene chloride	U - 110	12	7 - 12
acetone	U - 650	65	U
1,1-DCE	U - 5*	0	U
1,1-DCA	U - 1500*	25	U
1,2-DCE	U - 20	1	U
TCE	U - 29*	0	U
PCE	U - 32,000	550	U
TPH (ppm)	ND - 4400	514	74 - 92

\* Detected in one sample only.

FIGURE 13. RI/FS SHALLOW GROUNDWATER ANALYTICAL RESULTS

Total Volatile Organic Concentration in Groundwater, excluding methylene chloride (ug/l)

	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	VWCB Surface Water Standards
Shallow sample	3446	7800	13	60	76	130	9	4	
Deep sample	2395	6320	15	84	67	671	78	4	

Ranges of Concentrations

acetone	150 - 1300	920 - 960				U - 460			N/A
DCA	210 - 290	520 - 540				U - 16			N/A
DCE	130 - 230	400 - 430				50 - 120			N/A
TCA	660 - 1100	270 - 390				U - 1			170000
carbon tetrachloride	72 - 120	U				U			80.7
TCE	34 - 66	490 - 560				U - 47			80.7
PCE	170 - 220	3700 - 4800				3 - 91			3519

TPH	25 - 43	U	U	U	30 - 60	25 - 50	30 - 60	20 - 30	1
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Inorganics (ug/L)

	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	VWCB Ground- water Standards
arsenic		171		14.8	337				50
cadmium		8		15	96				0.4
chromium		281		206	1120				50
copper		75		55	261				1000
lead		116		102	516				50
mercury		0.22		U	U				0.05
zinc		354		416	1580				50



FIGURE 14. RI/FS DEEP GROUNDWATER ANALYTICAL RESULTS

Volatile organics (ug/l)

	DW-1	DW-2	VWCB Surface Water Standards
methylene chloride	27	8	N/A
acetone	160	U	N/A
1,1-DCE	3	3	N/A
chloroform	19	60	470
1,1,1-TCA	U	3	170,000
bromodichloromethane	U	4	N/A
TCE	U	2	80.7
PCE	U	3	3519

## RI/FS WORK REMAINING

- Pumping test
- Modeling
- Risk assessment
- Feasibility Study